

CLAIMS

What is claimed is:

1. Amide metathesis and transamidation reactions comprising reacting in a solvent at least two reactants, the reactants comprising at least two distinct amides, or at least one amide and at least one amine, in the presence of a metal-containing catalyst, at a temperature of about 250°C or less, wherein a reaction takes place and the reaction is selected from the group consisting of transamidation and amide metathesis reactions.
2. The reaction of claim 1, wherein the reactants are reacted at a temperature of about 150°C or less.
3. The reaction of claim 1, wherein the reactants are reacted at a temperature of from about 90°C to about 150°C.
4. The reaction of claim 1, wherein the reactants are reacted at a temperature of from about 90°C to about 250°C.
5. The reaction of claim 1, wherein the metal-containing catalyst is selected from the group consisting of amido-ligated transition or main group metals, transition metals bearing anionic ligands, main group metals bearing anionic ligands, Lewis acidic metal complexes, and combinations thereof.
6. The reaction of claim 1, wherein the reactants are reacted in an aromatic, non-polar, aprotic solvent.

7. The reaction of claim 1, wherein the reactants are reacted in a solvent selected from the group consisting of benzene and mono-, di-, and tri-alkyl-substituted benzenes.
8. The reaction of claim 1, wherein the reactants are reacted in toluene.
9. The reaction of claim 1, wherein the metal-containing catalyst is selected from the group consisting of: $\text{Sc}(\text{OTf})_3$, $\text{Ti}(\text{NMe}_2)_4$ and $\text{Al}_2(\text{NMe}_2)_6$.
10. A method of synthesizing oligo- or polyamides comprising reacting amine-amide reactant combinations in a solvent, in the presence of an aluminum-, lanthanum-, scandium-, tantalum-, tin-, titanium-, ytterbium- yttrium-, or zirconium-containing catalyst, at a temperature of from about 90°C to about 250°C, wherein a transamidation reaction takes place.
11. An amide metathesis reaction comprising reacting in a solvent two distinct amide-containing molecules, in the presence of a metal-containing catalyst, at a temperature of about 250°C or less, wherein an amide metathesis reaction takes place.
12. The reaction of claim 11, wherein the amide-containing molecules are reacted in an aromatic, non-polar, aprotic solvent.
13. The reaction of claim 11, wherein the metal-containing catalyst is selected from the group consisting of: $\text{Sc}(\text{OTf})_3$, $\text{Ti}(\text{NMe}_2)_4$ and $\text{Al}_2(\text{NMe}_2)_6$.

14. The reaction of claim 11, wherein the metal-containing catalyst is selected from the group consisting of aluminum-, lanthanum-, scandium-, tantalum-, tin-, titanium-, ytterbium- yttrium-, and zirconium-containing catalysts, and the amide-containing molecules are reacted at a temperature of from about 90°C to about 250°C.
15. A transamidation reaction comprising reacting in a solvent at least one amide with at least one amine, in the presence of a metal-containing catalyst, at a temperature of about 250°C or less, wherein a transamidation reaction takes place.
16. The reaction of claim 15, wherein the amide and the amine are reacted in an aromatic, non-polar, aprotic solvent.
17. The reaction of claim 15, wherein the metal-containing catalyst is selected from the group consisting of: $\text{Sc}(\text{OTf})_3$, $\text{Ti}(\text{NMe}_2)_4$ and $\text{Al}_2(\text{NMe}_2)_6$.
18. The reaction of claim 15, wherein the metal-containing catalyst is selected from the group consisting of aluminum-, lanthanum-, scandium-, tantalum-, tin-, titanium-, ytterbium- yttrium-, and zirconium-containing catalysts, and the amide-containing molecules are reacted at a temperature of from about 90°C to about 250°C.
19. A method fabricating combinatorial libraries comprising amide-containing and/or amine-containing molecules, the method comprising reacting in a solvent a plurality of reactants, the reactants comprising a plurality of at least two distinct amides, or a plurality of at least one amide and at least one amine, in the presence of a metal-containing catalyst, at a temperature of about 250°C or less, wherein a reaction takes place and the reaction is selected from the group consisting of transamidation and amide metathesis reactions.